

3 Branches of the Same Tree: Art, Science and Education



**A teacher's Resource Pack for
Key Stage 2 students**



**Focusing on curriculum topics:
Forces & Magnets, Light and Sound**



Part 4 of 4: Glossary



**Alongside the exhibition at Pump House Gallery
23 April - 31 May 2015**

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Department
for Education

THE BRIGHTER BOROUGH

Wandsworth

Introduction

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3 Branches of the Same Tree brings together theories and concepts of science, art and education. The project has formed through the collaboration between three artists, three scientists and teachers from six Wandsworth-based primary schools. The aim was to create an exhibition of new work developed from research into Key Stage 2 curriculum areas of Light, Forces & Magnets and Sound. The exhibition aims to explore how art can be used as an access point into traditionally challenging areas, the outcomes of which are complemented by this Teacher's Resource Pack.

Beginning in September 2014, the project has involved each artist engaging in scientific research through close collaboration with a scientist and teachers from two Wandsworth primary schools. The process began with six working group sessions exploring the curriculum areas, where activities developed and ideas were tested out with students. Initially looking at the ways science can be taught, from January to March the artists' work developed as they applied their practice to question how the lenses of science and art affect our perception of the world.

This Resource Pack has been created alongside the artists' work as it has developed. Working with Primary Science Consultant Naomi Hiscock, Art Consultant John Tucker and Art Teacher Hazel Hardy, the activities in this Pack aim to locate the meeting point between art and science. Designed for and by Science teachers, it was vital that the art explored developed the students' scientific knowledge. As ideas were tested and checked over, the cross-overs between the practices of both scientists and artists became increasingly visible. The 18 activities bring together artists from around the world, linking those from the past and today and the work developed by the project artists. The activities not only meet the curriculum requirements but will inspire curiosity, learning and understanding of both art and science.

Artistic duo Semiconductor Ruth Jarman and Joe Gerhardt worked alongside biophysicist Ben Robinson and teachers Jane Bettles from West Hill and Jenny Taylor and Peggy Cowdry from St Anne's primary schools to explore Light. The group explored photograms by artist Man Ray, created

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shadows of objects and paths of light as it reflects off surfaces. The critical moment that directed the outcome of the activities was the understanding that everything you see is reflected light. Early on in their research, Semiconductor came across a satellite called Landsat which captures images of the Earth and reflected light. Although this satellite programme has been running since 1972, in 2013 introduced a new band, 'Band 9', which captures a very small wavelength of light (1.38 microns) reflected from Cirrus clouds. Their work, *Band 9*, is an installation of light boxes presenting very high contrast, highly detailed images that capture the clouds from above and the reflected sunlight. Viewers are offered a different perspective of something familiar – the clouds from above.

Artist Alistair McClymont worked with neuroscientist Aleksandra Berditchenskaia and teachers Nancy Leeming and Nicolle Atkin from Griffin and Emma Pring and Kitty Russell from Falconbrook primary schools. Exploring students' understanding of how sound travels in vibrations, the group tested out ideas with elastic bands, specialist

technology and mark making. As the project developed, McClymont's work focused on the connection we have with sound from scientific perspectives through to its use in contemporary music. The work *One should never mistake pattern... for meaning (Function Generator)* has been set up as an ongoing project involving experiments in collaboration with Berditchenskaia, and live performances with scratch DJ and producer Prime Cuts and artist and musician Tom Richards.

Working with scientist Max Boleininger and teachers Sarah Daniell and Pat Dickens from All Saints CE and Lara Ahmoye from Hotham Primary Schools, artist Lyndall Phelps has researched the possibilities of forces and magnets. As they tested out ideas with students, Phelps became fascinated by the apparent magic of magnets. Phelps has developed a series of installations for the exhibition that invite visitors to explore and interact with the effects magnets have on their surroundings. Using specialist materials, such as powerful magnets and liquid magnets, Phelps provides opportunities to test out and explore the mysteries of magnets.

This Resource Pack is available as an online downloadable PDF. The exhibition (23rd April – 31st May) is open for school groups to visit. For more information, please contact the gallery on 020 8871 7572 or email info@pumphousegallery.org.uk

We would like to thank all the teachers, artists and scientists involved in making this pack. We would like to thank Clare Thurman, Action Learning Facilitator, Davina Salmon, Education and Social Services Department, Wandsworth Borough Council and Ella Lewis-Williams, Project Assistant and Danielle Morris, Pump House Gallery Intern. We would also like to thank first4magnets and Beehive Coil Ltd for their support in providing materials for the exhibition.

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Pump House Gallery

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GLOSSARY

Key facts and terms

Forces & Magnets

What is a force:

Force is defined as the effect through which an object is deformed or its motion is changed. Thus a force can change the speed of an object, causing it to accelerate. The heavier the object, the force less the acceleration will be. A 'vector quantity' which is described by both direction and magnitude, the latter being represented in units of newton. The direction in which a force acts can be pictured as a pushing or pulling effect. The unit newton is named after the scientist Isaac Newton who gave the concept of force in its second law of motion.

What is contact and non contact force?

The most common classification of force is contact and non-contact force. Contact force exists in the physically attached surfaces like normal force, surface friction force etc. Non-contact force is that which is exerted between physically detached objects, like wind and through magnet.

What materials are magnetic and which aren't?

Magnetic Materials:

These are materials attracted by magnets. Iron, cobalt, and nickel are the only common metals that are found magnetic in their pure state. We have since developed other magnetic alloys which are based on the magnetic metals. You will find some iron nails, keys, metal spades, needles, door handles, or coins to be magnetic.

Non-Magnetic Materials:

These materials are not attracted towards magnets. For example; wood, rubber, plastics, coins, leather and feather are non-magnetic in nature. Metal alloys can also be designed to be non-magnetic, even if they contain a magnetic metal such as iron.

Key facts and terms

Forces & Magnets

The Earth as a magnet

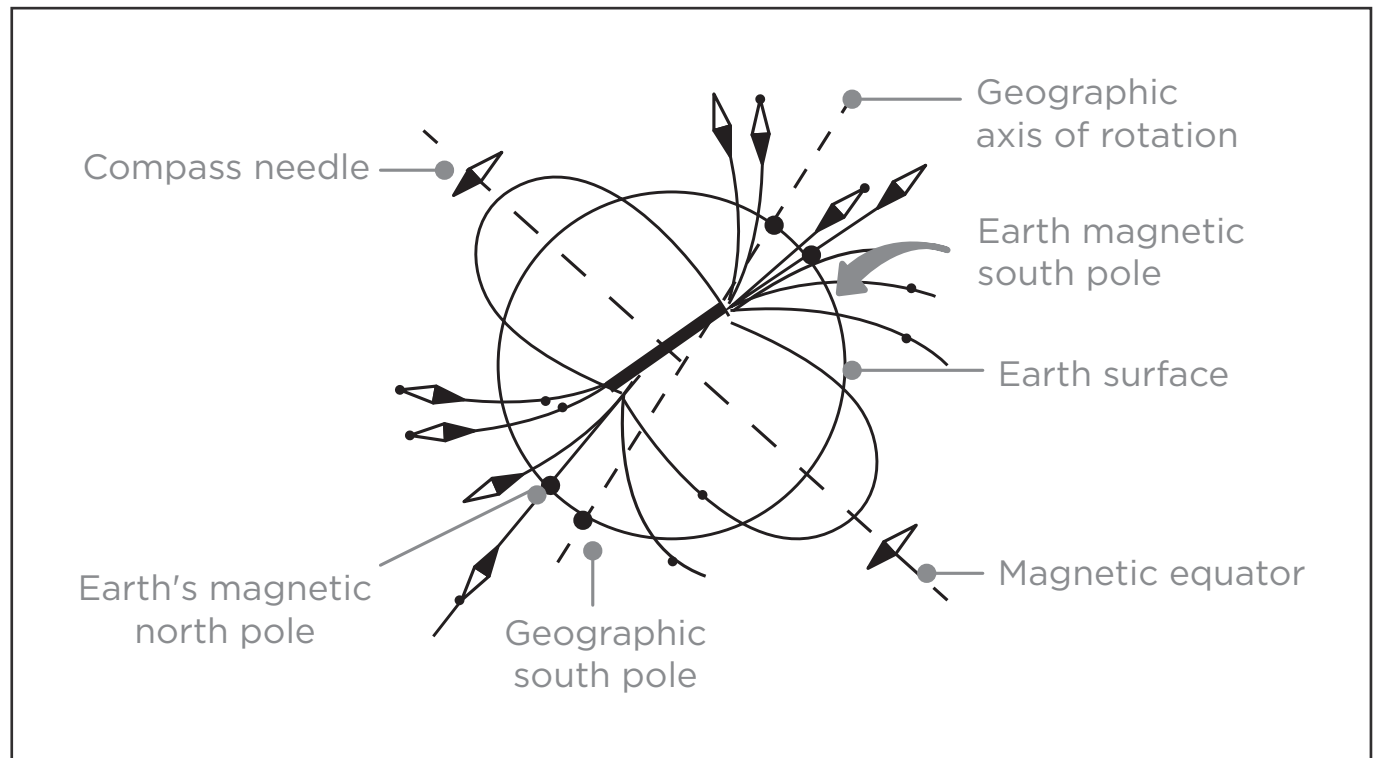
Around AD1600, William Gilbert, who was a court physician of Queen Elizabeth I, performed certain experiments using spherical lodestones. When he placed small, pivoted magnetic needles at different positions on this sphere, he found that their behaviour was quite similar to that of magnetized needles at corresponding places on Earth's surface. Later he concluded that Earth behaves like a huge magnet.

The cause of the Earth's magnetism has not yet been understood clearly. In the earth's outer core there is a high concentration of ferromagnetic material in molten state. It is believed that as a result of the rotation of the Earth, the molten material flows in the form of currents around the solid inner core. These currents are supposed to be responsible for the terrestrial magnetic field. This magnetic field appears to enter the Earth at the north pole and leaves at the south pole.

It should be noted that the magnetic poles do not coincide with the geographic poles. The magnetic poles move slightly from year to year. The branch which studies the terrestrial magnetism is known as Geomagnetism.

Source:

<http://www.tutorvista.com/content/physics/physics-i/magnetism/earth-magnet.php> and Max Boleininger, Doctoral training in Physics, Theory and Simulation of Materials, Imperial College, London.



Key facts and terms

Sound

How sound travels

Sound (vibrations) travels as waves.

(Sound) waves describe the process of transferring energy from one location to another without transferring matter.

When sound travels through the air, it travels by **longitudinal waves**. Longitudinal waves describe a wave motion where particles are vibrating parallel to the direction that the wave is travelling. When sound travels through the air, air particles close to the sound source vibrate and these air particles knock into their neighbouring particles, causing them to vibrate and so on. These vibrations cause a series of pressure oscillations (successive areas of air particle compression and rarefaction).

Transverse waves are at 90° to the direction of travel. We can depict the sound wave as a transverse wave when describing the pressure changes over time, relative to atmospheric pressure (the normal spacing of air particles in the air).

This website explains how sound waves interact with the eardrum: <http://www.physicsclassroom.com/mmedia/waves/edl.cfm>

How pitch differs

Sounds of different pitches have different wavelengths.

The number of wavelengths (in other words, the number of pressure oscillations) per second is the frequency of the sound wave. For example, the higher the sound, the closer successive areas of air particle compression are to one another. The pitch or frequency of a sound is measured in **hertz (Hz)**. See Figure 1 – see scans

How volume differs

Sounds can also vary in volume (loudness). This just means that for louder sounds, the pressure oscillations are larger as the sound travels through the air.

The volume of a sound is measured in **decibels (dB)**.

How people hear pitch differently

As people get older, the range of frequencies they hear becomes narrower due to a combination of factors that affect the functionality of the cells of the inner ear:

- 1 **Sensory factors:** functionality of the hair cells of the cochlea and their supporting cells is compromised.
- 2 **Neural factors:** the functionality of the nerve cells relaying auditory information from the ear to the brain is compromised.
- 3 **Metabolic factors:** processes in the inner ear related to the build up of ions that cause degradation of mechanical structures.

Age-related hearing loss is typically more pronounced at higher pitches.

Source: Aleksandra Berditchevskaia, PhD study in Bioengineering (Neurotechnology), Imperial College, London.

Figure 1

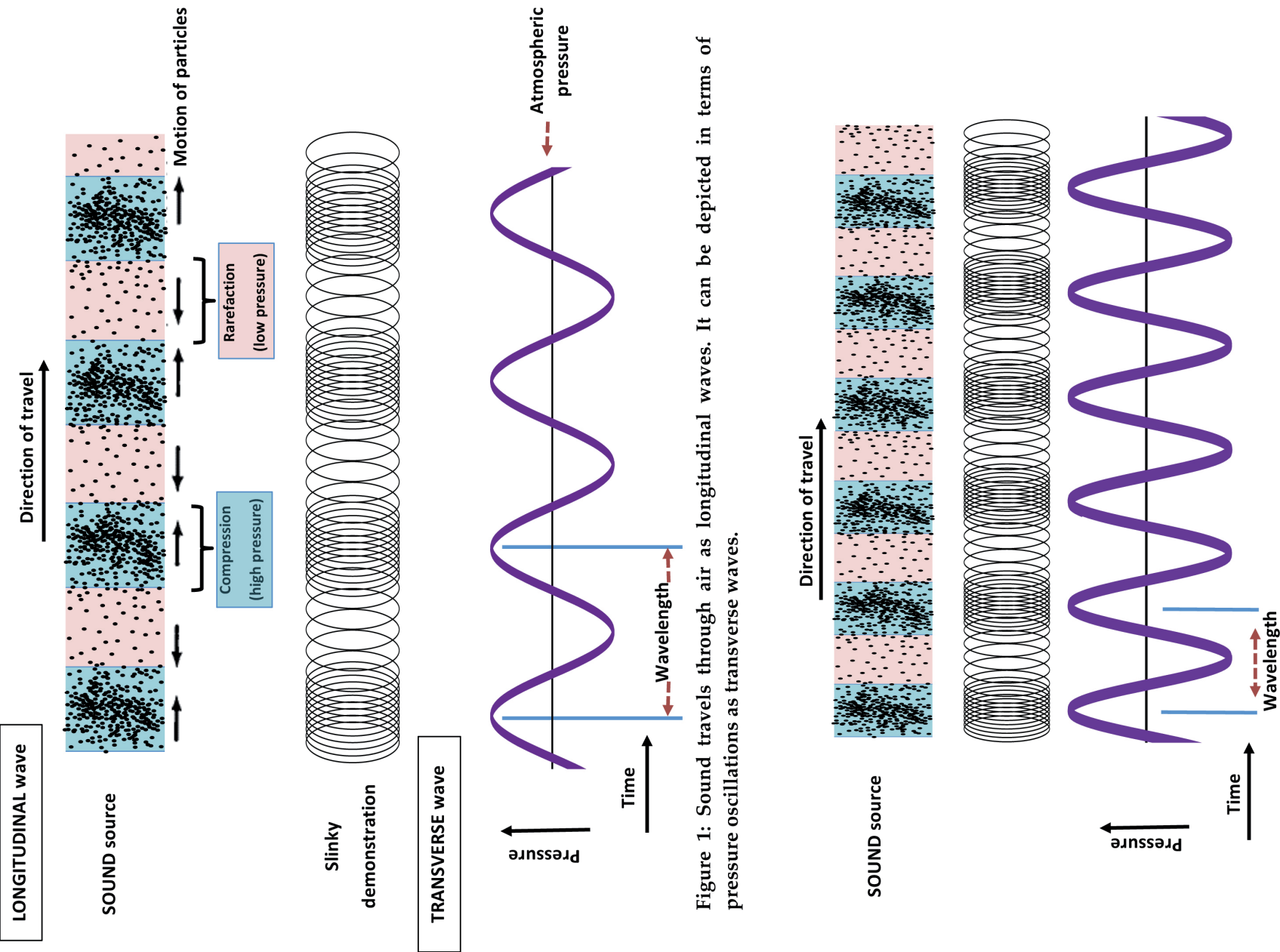


Figure 1: Sound travels through air as longitudinal waves. It can be depicted in terms of pressure oscillations as transverse waves.

Key facts and terms

Light

How we see things:

Light is required to see things; the reflection of light off of objects is how the eye is able to view the world around and transmit this information to the brain. The dependence on this is noticable in low light conditions where less light is available to reflect off of objects makes it harder to see the world around.

Single bulb torch

To produce a good shadow or beam of light to demonstrate reflection properties it is important to have a single source of light. Torches with multiple LEDs act as multiple light sources, which may cause multiple shadows or less coherent beams of light, which may confuse the demonstrations/activities of light principles.

Quality of shadows

The quality of a shadow created by an object may be affected by effects relating to the translucency or reflected properties of the object. With translucent objects, some light is still transmitted through the object to the shadow region, making it lighter and less defined.

With reflective objects (or those with a reflective coating) the edges of the shadow may become less defined as some extra light is transmitted to those regions of the shadow, making the contrast between light and dark lower.

Source:

Dr. Benjamin Robinson, Post-doctoral Research Associate, Department of Bioengineering Cellular and Molecular Biomechanic, Imperial College, London.

Art terms

Abstract: A term generally used to describe art that is not representational or based on nature

Abstract Expressionism: An American artistic movement in the 1940s and 1950s, usually characterised by large abstract painted canvases

Assemblage: A three-dimensional composition made from a variety of traditionally non-artistic materials and objects

Colour: The perceived hue of an object, produced by the way in which it reflects light into the eye

Composition: The arrangement of elements within a work of art as to form a unified whole

Conceptual art: Art that emerged in the late 1960s, emphasising ideas rather than the creation of visual forms

Continuous Line Drawing: A method of drawing where the drawing tool stays in constant contact with the paper during the entire length of the activity, producing an unbroken line.

Cubism: An artistic approach to representing reality invented by artists Pablo Picasso and Georges Braque in which the artists aimed to bring different views of their subjects together in the same picture

Form: The shape or structure of an object or visual element

Line: A long mark or stroke

Mark-making: A term used to describe the ways of producing varying lines, patterns, and textures when making two-dimensional artwork. Possible techniques include dots, lines, swirls and cross-hatching. Mark-making can be light, loose and gestural, heavy, structured or controlled

Medium: The materials used to create a work of art

Negative shapes/space: The area surrounding a defined shape, i.e. the background, is negative space

Pattern: A series of visual elements that repeat

Peephole box: A box containing a set of pictures or objects which can be viewed through a small hole. Historically, the boxes were often decorated inside to resemble theatrical scenes

Perspective: An artistic technique used to depict volume and spatial relationships on a flat surface, as in a scene that appears to extend into the distance

Photogram: A photographic print made by placing objects and other elements on photosensitive paper and exposing it to light

Shape: The form in which an object exists or appears

Surrealism: An artistic movement that began in Paris in 1924 that was interested in exploring the irrational, subconscious mind

Texture (actual): The tactile quality of the surface of an object – how it feels if touched

Texture (visual): How a sense of actual texture is conveyed through the sensitive use of artistic marks and materials on a flat surface

Tone: The lightness or darkness of a colour

Materials

Magnets:

<http://www.first4magnets.com>

North/South Magnets:

<http://www.first4magnets.com/rectangular-magnets-c35/2-educational-alnico-bar-magnets-north-south-identified-11-x-6-x-75mm-p2477>

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- [Fun magnet facts](#)
- [A beginners guide to magnetism](#)
- [Magnet quiz](#)
- [A history of electricity and magnetism](#)

Visit www.education.first4magnets.com to find out more. Alternatively, you can contact their customer service team on 0845 519 4701 or by emailing sales@first4magnets.com

Wire

- **Craft wire** (this is generally non-magnetic wire): <http://www.espo.org/Catalogue>

- **Modelling wire** (this is magnetic wire): <http://www.espo.org/Catalogue>

Handy torch (this is a single bulb torch):

<http://www.espo.org/Catalogue>

Sunprint paper

<http://www.sunprints.org/>

Printing tiles, Polystyrene (this can be used as a foam board):

<http://www.espo.org/Catalogue>

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